

Study of internal carotid artery, vertebral artery, basilar artery in the brain

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Abstract

Thorough knowledge of the anatomy of the intracranial vessels is important to clinicians as well as basic scientists who deal with the problems related to intracranial vasculature on daily basis. As human brain is the instrument of high intelligence that distinguishes man from other living creatures, the study of blood supply to brain is of greater significance. The author secured a total number of 70 brains and dissected them to study the arterial supply to brain. The ICA, the stable component of circle of Willis which bifurcates into its two terminal branches. the vertebral arteries are large branch of the subclavian arteries. In the majority of cases, the left VA is the dominant artery. In the present study also the left vertebral dominance is quite obvious. 62.865% of specimen showed left dominance, where as the right VA is large only in 22.86% specimens. A very few specimens (14.29%) have showed equality on both the sides. The BA, which is formed by the union of two vertebral arteries, is normal in its formation in 91.43% of brains. In 7.14% brains it is 3 mm below the caudal border of pons and in 1.43% specimens it is 2 mm above the caudal border. The termination of the basilar artery is at the cranial border of pons in all 100% brains.

Keywords: Arteries, Basilar artery (BA), Brain, Internal carotid artery (ICA), Vertebral artery (VA).

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thorough understanding and appreciation of normal anatomical vascular pattern and variational anatomy of blood vessels. Vascular disease in general is the commonest cause of death all over India as well as most other countries. The diseases of blood vessels of the brain which are more frequent causes of death and disability have not attracted as much public attention as they required. (Prasad and Lal)¹⁰ So a study of vascular supply of brain and its variational anatomy will help on proper and thorough understanding and interpretations of infarction, embolism, thrombosis and other connected problems through modern investigation methods (non-invasive techniques), MRI, MRA, CT angiography and TCCD etc. Hence this work has been taken up, selecting the dead human foetuses and adult human cadavers from Indian population.

INTRODUCTION

Human behaviour comes from the human brain. The brain in human beings differ from that of all living creatures, which is an instrument of almost unlimited potentialities as regards high intellectual factors, cultivation of skilled movements of increasing degree of complexity, adaptation, to diverse circumstances. The vast growth of pallium requires a perfusion of vascular supply to maintain its functional needs. Hence knowledge of detailed anatomy of blood supply of brain is of great importance to the neurologists to appreciate normal and abnormal activities of brain. Neurosurgeons dealing with various neurosurgical problems of brain require a

MATERIAL AND METHODS

The present work consists of the study of the Internal carotid artery, Basilar artery and Vertebral artery in Brain, both adult and foetal cadavers of Indian population. 20 specimens of adult brains with intact vasculature are collected in Department of Anatomy, Guntur which was kept for medical students for routine dissection. Dead foetuses, while they were still fresh were

collected from the labour room of maternity wing of Govt. General Hospital, Guntur. The age of the foetuses are calculated by crown-rump length. The length is ranging from 225mm-310mm. and the age is roughly estimated between 20wks-38 wks. Removal of Brain: soon after the fresh foetuses are brought to the Department of anatomy, from Govt. General Hospital, Guntur, the following procedure is followed to remove the brain. To remove the skull cap, after the dead foetuses are placed in a tray in a supine position, a circular skin incision is given with a scissors, 1 cm. above the eyebrows in the frontal area, running laterally and posteriorly above the ears and ending at the posterior fontanelle. With the scissors, penetrating deep to the bone in the region of pterion a cut is made in the bones along the line of skin incision as the foetal bones are thin and membranous in character. Soon after the foetal brains are taken out in the process described above, they are kept carefully in 10% formaline solution in plastic tins. The adult brains are removed following the procedure described in Cunningham's Manual for routine dissection for medical students and preserved in 10% Formaline solution. Dissection is performed after the Brain is fixed in preservative solution, and the intracranial vascular pattern is studied carefully. Every artery is observed carefully to know the pattern and whenever it is necessary photographs are taken. After the study is over the specimens are replaced in their respective preservative solution.

OBSERVATIONS AND RESULTS

During the course of study the following aspect of each artery are observed minutely. The following table shows artery wise variational abnormalities in adult and foetal specimens for comparison:

Name of the artery	Aspects studied
1 Internal carotid artery (ICA)	Lumen size differences between right and left.
2 Basilar artery (BA)	Formation, Termination and Length.
3 Vertebral artery (VA)	Right and Left length differences.

Internal carotid artery: Table no 1

The size of the lumen of ICA is equal on both right and left sides in 46/70 (65.71%), particularly in adults, it is equal in 16/20 (80%). ICA on right side is larger in 8/70 (11.43%) specimens.fig.no. 3. on left side ICA is larger in 16/70 specimens, i.e.,(22.83%).fig.no.2. On examination of the total specimens the artery is present in all the 100% specimens.

Vertebral artery: Table no 2

The present study reveals that the VAs on the left side are large in most of the specimens i.e. 44/70 (62.86%) fig no

5. The right side VA, according to present study, is larger in 16/70 (22.86%) specimens, fig no 4. A very less number of vertebral arteries have showed equality on both sides i.e. 10/70 (14.29%) fig no 5. According to present study, the left vertebral artery is larger in majority of the cases.

Basilar artery: Table no 4

The formation of BA, in the present study is normal in a considerable percentage i.e. in 91.43% (64/70) specimens. In 5/70 (7.14%) specimens formation of this artery has been noticed 3 mm below the caudal border of pons fig no 8. In one specimen the formation is seen 2 mm above the caudal border, fig no 7. We have noticed that the termination of the basilar artery at the cranial border of pons in 100% (70/70) specimens. We found the length of the basilar artery in ranging from 13 mm to 18 mm in foetal specimens and from 23 mm to 32 in adult specimens. The BA, in the current study has a mid-line course in all the specimens (70/70, 100%).

DISCUSSION

In the present study, the size of the lumen of ICA are equal on both sides in 46/70 (65.71%), specially in the adults, it is equal on right and left sides in 16/20 (80%) specimens in relevance with L. Jayaraj *et al*, who stated that no variations had been observed in the stem of ICA. ICA on right side is larger in 8/79 (11.43) specimens. fig.no.3 on par with the findings of Orlandini⁹ who noticed that the right and left ICAs were unequal in size. Regarding the left side, ICA shows larger in 16/70 (22.83%) fig. no. 2, in co-ordination with Ronald A. *et al*¹¹. On examination of the total specimens the artery is present in all the 100% specimens. The present study reveals that the VAs on the left side are large in most of the specimens i.e. 44/70 (62.86%) fig no 5, in parity with Stopford J.S.B.¹², Hollinshead⁴, Kreyambuhl and Yasargil⁶, Orlandini.G.E.⁹. The right side VA, according to present study is larger in 16/70 (22.86%) specimens, fig no 4, in similarity to the studies of Raja Reddy *et al*¹⁰ Kreyambuhl and Yasargil⁶, Orlandini G.E⁹. A very less number of VA have showed equality on both sides i.e. 10/70 (14.29%) fig no 5, in co-ordination with Stopford J.S.B¹², Hollenshead⁴, Orlandini G.E.⁹, Kreyambuhl⁶, Raja Reddy *et al*¹⁰. Where in they have noticed 50% of equal VAs on both sides. According to present study, the left VA is larger in majority of the cases. Table no 3. The formation of BA, in the present study is normal in a considerable percentage i.e. in 91.43% (64/70) specimens. In 5/70 (7.14%) specimens formation of this artery has been noticed 3 mm below the caudal border of pons fig no 6. In one specimen the formation is seen 2 mm above the caudal border, fig no 7. All the above mentioned findings of the present author are coherent to

that of Jayasree N and Sadasivan G.⁵ who found the formation of BA at a higher level in 4% and lower level 14% cases. We have noticed that the termination of the BA at the cranial border of pons in 100% (70/70) specimens. We found the length of the BA is ranging from 13 mm to 18 mm in foetal specimens and from 23 mm to 32 in adult specimens collaborating the earlier authors Adachi B¹. The Basilar Artery, in the current study has a mid-line course in all the specimens (70/70, 100%) which could be coopted onto Takahashi.M.¹³

Table 1: Showing the size of the Internal carotid artery in the Present Study:

No. Specimens	of Equal	Right Large	Left Large
Adult	20	16	01
Foetuses	50	30	07

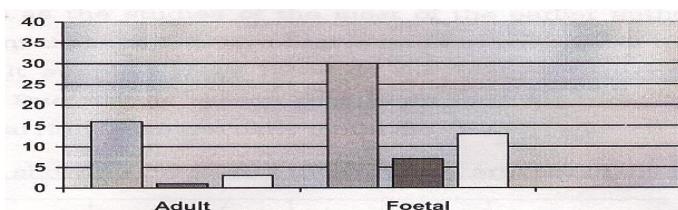


Table 2: Vertebral artery table showing the size of the vertebral arteries of the present study

Number of specimens	Equal	Right large	Left large
Adult	20	1	4
Foetal	50	9	12

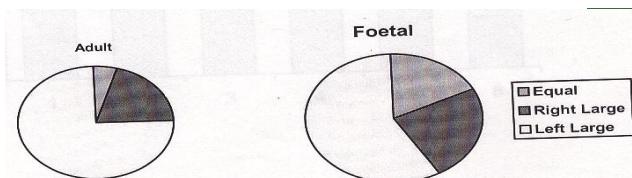


Table 3: Vertebral artery comparative study of present author with that of earlier authors

		Left Larger	Right Larger	Equal
1	Present Study	62.86%	22.86%	14.29%
2	Stopfore J.S.B. 1916-17	51%	41%	8%
3	Hollinshed 1962	More than half	Less than half	8%
4	Kryanbuhl & Yasargil 1957	42%	32%	26%
5	Orlandini 1970	53%	--	--
6	Raja Reddy et al 1972	23%	27%	50%

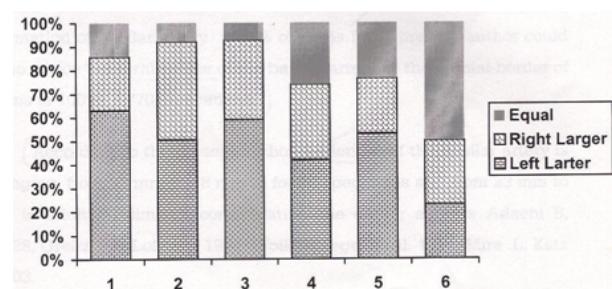


Table 4: Size of Basilar Artery

No. of Specimens	Maximum in mm	Minimum in mm	Average in mm
Adult	33	23	28
Foetal	18	13	15.5

Table 5: Showing the formation and termination of basilar artery

No. of Specimens	Formation			Termination		
	Normal	Caudal	Cranial	Normal	Caudal	Cranial
Ital	20	18	1	1	20	--
al	50	46	4	--	50	--



Figure 1



Figure 2



Figure 3



Figure 4



Figure 5



Figure 6

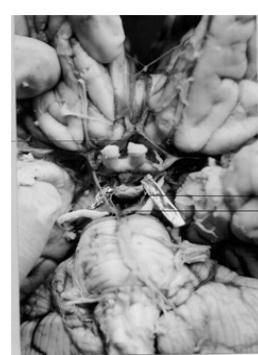


Figure 7

Legend

Figure 1: Showing right ICA wider **1)** Right ICA is wider **2)** Right VA is larger

Figure 2: Showing left ICA larger **1)** ACoA is absent. **2)** ACA larger (left). **3)** Left ICA is larger. **4)** BA midline

Figure 3: Right VA larger **1)** ACoA. **2)** Left PCoA is absent **3)** Right VA larger, **4)** Right ICA larger

Figure 4: Right VA larger **1)** Right ICA has wider lumen **2)** Union of both VA are 3mm below caudal border of pons **3)** BA is in the midline **4)** Right VA larger.

Figure 5: Left VA is larger **1)** Right PCoA larger **2)** BA is in the midline, **3)** Left VA larger.

Figure 6: Formation of BA 3mm. Below the caudal border of pons **1)** Right ACA larger, **2)** BA formation 3mm below the caudal border of pons **3)** Left VA is larger

Figure 7: Showing BA 2mm.above the caudal border of pons

CONCLUSIONS

We feel that the high incidence (frequency) of cerebral vascular diseases leading to organic and functional disorders as we found in our small cross section of study so many anomalies in the vascular pattern, which are self explanatory to appear as neurological problems. Hypo or hyper fusion of the arteries lead to variation in length of the artery. The variations in formation and termination of Basilar artery appears to be congenital. A knowledge about variation of the arteries is essential for planning any surgery on brain to achieve best post operative prognosis.

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